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IS 11018-2 (1984): Expression of properties of cathode-ray oscilloscopes, Part 2: Storage oscilloscopes [LITD 8: Electronic Measuring Instruments, Systems and Accessories]

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IS : 11018 (Part 2)-1984
IEC Pub 351-2 (1976)

(Reaffirmed 2000)

Indian Standard

EXPRESSION OF THE PROPERTIES OF CATHODE-RAY OSCILLOSCOPES

PART 2 STORAGE OSCILLOSCOPES

National Foreword

This Indian Standard (Part 2), which is identical with IEC Pub 351-2 (1976) 'Expression of the properties of cathode-ray oscilloscopes, Part 2 : Storage oscilloscopes', issued by the International Electrotechnical Commission (IEC), was adopted by the Indian Standards Institution on the recommendation of the Electronic Measuring Equipment Sectional Committee and approved by the Electronics and Telecommunication Division Council.

Cross Reference

International Standard	*Corresponding Indian Standard*
IEC Pub 351-1 (1976) Expression of the properties of cathode-ray oscilloscopes, Part 1 : General	IS : 11018 (Part 1)-1984 Expression of the properties of cathode-ray oscilloscopes : Part 1 General (Technically equivalent)

Note 1 — The French text given in the IEC Publication has been dropped while adopting the Publication as Indian Standard.

Electronic Measuring Equipment Sectional Committee, LTDC 21 [Ref : Doc : LTDC 21 (682)]

Adopted 11 September 1984	© July 1985, ISI	Gr 4

INDIAN STANDARDS INSTITUTION
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NEW DELHI 110002

1. General

This standard should be used in conjunction with IEC Publication 351-1, Expression of the Properties of Cathode-ray Oscilloscopes, Part 1: General.

1.1 *Scope*

1.1.1 This standard applies to storage oscilloscopes with special devices incorporated in the cathode-ray tube permitting the recording of a signal in another way than by the ability of the screen coating to ensure persistence of the display of information.

1.1.2 This standard does not apply to oscilloscopes with a normal tube and storage devices external to the tube. However, some clauses of the standard may be applied with agreement between the manufacturer and the user

1.1.3 This standard does not apply to oscilloscopes which have a cathode-ray tube having a screen with long persistence which temporarily retains the display.

1.1.4 Certain types of storage oscilloscopes are capable of operation without storage. When so operated, Publication 351-1 applies directly. In this standard, it is assumed that the oscilloscope is operated, unless otherwise stated, as a storage oscilloscope.

1.2 *Object*

The object of this standard is the standardization of methods of expression of the properties of storage oscilloscopes and particularly:

- the definition of special terminology and catalogue data related to these types of apparatus;
- the specification of conditions and methods for testing these types of apparatus in order to verify compliance with properties claimed or specified by the manufacturer.

2. Terminology

For the purpose of this standard, it has been agreed that the special meanings contained in the following clauses shall apply. Definitions taken from the International Electrotechnical Vocabulary (I.E.V.) are shown by the reference to I.E.V. Group 07 or 45.

2.1 *Storage oscilloscope*

An oscilloscope using a storage cathode-ray tube, called a storage tube.

2.2 *Persistence*

The ability of the cathode-ray tube screen to retain information temporarily after the spot has moved on, with the luminance of the display gradually fading away.

2.3 *Storage tube*

A cathode-ray tube which retains information by means of a process other than normal persistence of the screen.

2.3.1 *Bistable storage cathode-ray tube*

A cathode-ray tube, the elementary storage cells of which can cause the screen to have only two values of luminance.

2.3.2 *Half-tone storage cathode-ray tube*

A cathode-ray tube, the elementary storage cells of which can cause the screen to have a range of luminance values between zero and a maximum value.

2.3.3 *Mesh storage cathode-ray tube*

A cathode-ray tube using a storage mesh (see Sub-clause 2.4.2.1)

2.3.4 *Screen storage cathode-ray tube*

A cathode-ray tube using a special screen as a storage unit.

2.4 *Parts of the cathode-ray tube*

2.4.1 *Screen*

The surface of the tube upon which the visible pattern is produced (I.E.V. 07-30-145).

2.4.2 *Storage target*

A target made of a great number of elementary cells, the electrostatic state of which is modified by the impact of the electron beam from the writing gun.

Note. — The secondary electrons emitted by the storage target are collected by a collector mesh, by the walls of the tube or by a conductive transparent coating on the face plate.

2.4.2.1 *Storage mesh*

A particular kind of storage target consisting of a metallic mesh with a dielectric coating.

2.4.3 *Writing gun*

An electron gun (analogous to the gun of a tube without storage) used to modify the state of the storage target by recording on it the display to be observed,

2.4.4 *Flood gun*

An electron gun used to deliver a broad electron beam covering uniformly the entire storage target.

2.4.5 *Split screen*

A storage screen with two (or more) areas which can be separately controlled (for example, one zone being used for storage, the other zone for observation without storage).

2.5 *Terms concerning storage*

2.5.1 *Storage*

An operation in which the representation of the signal can be preserved by the storage tube, with or without display, until it is erased.

2.5.2 *Writing*

A storage process in which the movement of the electron beam from the writing gun is recorded.

2.5.3 *Capabilities of storage and display*

2.5.3.1 *Retention (save) time*

The period of time after writing during which the recorded information is preserved without display and at the end of which it may be displayed without deterioration beyond the limits specified.

2.5.3.2 *Display time*

The period of time during which the quality of the displayed trace is maintained without deterioration beyond the limits specified.

2.5.3.3 *Storage time*

The total period of time during which the recorded information is retained and displayed.

Note. — Storage time is not the sum of retention time and display time as determined in Sub-clauses 3.4 and 3.5.

2.5.3.4 *Variable persistence*

Persistence, the duration of which can be adjusted by means of a control at the user's disposal.

2.5.4 *Integration*

A process in which repetitive writing is used in order to increase the charges laid on the storage target and, consequently, the luminance of the display.

2.5.5 *Writing time*

The period of time needed to charge the cells of the storage target swept by the writing beam sufficiently to produce a display of specified luminance.

2.5.6 *Writing speed of a storage oscilloscope*

2.5.6.1 *Normal stored writing speed*

The speed of the writing beam at which it will record information under stated conditions of operation.

2.5.6.2 *Enhanced (fast) stored writing speed*

A writing speed, higher than the normal stored writing speed, at which it is still possible to store and to display a signal, but with reduced storage time and contrast.

Note. — See Clause 3, Item 2).

2.5.6.3 *Ratio of writing speeds*

(Under consideration.)

2.5.7 *Erase*

The operation of changing suitable electrode potentials in such a manner that previously stored information is removed.

Note. — Erasure can be carried out manually or automatically.

2.5.7.1 *Erase time*

The period of time between the start of erasure and the instant at which the luminance of the display reaches 10% of its initial value.

2.5.7.2 *Recycle time*

The period of time between the start of erasure and the instant at which writing can next commence.

2.6 *Terms concerning the appearance of the display*

2.6.1 *Luminance of a cathode-ray tube*

The quotient of the luminous intensity, in the direction perpendicular to the screen, of an infinitesimal element surrounding the considered point by the area of that element (I.E.V. 45-10-060 modified). The luminance is expressed in candelas per square metre (cd/m^2).

Note. — Only luminance is determinable. The term "luminosity", which is sometimes confused with "luminance", refers only to a visual sensation (I.E.V. 45-25-210).

2.6.1.1 *Photometer — Luminance meter*

A photo-electric device having an overall response approximating to the CIE standard photometric observer (according to Sub-clause 3.1.1 of CIE Publication 154-1).

2.6.1.2 *CIE standard photometric observer*

A receiver of radiation whose relative spectral sensitivity curve conforms to the $V(\lambda)$ curve (I.E.V. 45-10-016).

Note. — The curve $V(\lambda)$ is given in Table I of IEC Publication 50 (45) (I.E.V. 45-10-135).

2.6.2 *Background luminance*

The luminance measured on the surface of the screen outside the trace.

2.6.3 *Storage contrast ratio*

The ratio between the luminance of the trace and the luminance of the background.

2.6.4 *Luminance uniformity ratio*

The ratio between the maximum and minimum luminances of the trace or the background of a storage tube.

2.6.5 *Residual display*

A bright or dark display which is visible after erasure but which disappears after continued operation.

2.6.6 *Screen burn*

A local permanent destruction of the screen due to prolonged operation with an excessively bright stationary display.

2.6.7 *Target burn*

A local permanent destruction of the target coating due to uninterrupted operation with a writing beam.

2.6.8 *Resolution*

The maximum number of discrete vertical (horizontal) lines per centimetre which can be resolved in the stored display

3. Requirements and test methods

General:

1) Since most of the performance characteristics that follow are closely related to each other and depend a great deal on the individual settings of the control knobs, it is mandatory to leave all the controls at their preliminary settings while performing the tests specified in Sub-clauses 3.1 to 3.9 in sequence.
Preliminary setting of the controls is carried out by successive approximation to achieve optimum overall storage performance. When this is achieved, the settings of the controls and the results of the tests correspond to the normal usage of the storage oscilloscope; consequently, the figures obtained for the performance characteristics will not necessarily be the maximum possible values.

2) If, in addition, the manufacturer wishes to specify the maximum obtainable figures for any one of the characteristics given in Sub-clauses 3.1 to 3.9, he is entitled to do so. This may require different individual control settings for the measurement of each characteristic, and if so, this shall be clearly stated.

3) Ambient illumination shall be negligibly low in order not to affect luminance measurements.

4) The following performance characteristics may be interrelated and the manufacturer may wish to show these relationships by means of tables or graphs.

3.1 *Checking of the normal stored writing speed*

A substantially sinusoidal signal is applied to the vertical deflection input terminals. Its frequency is chosen according to the formula:

$$f\,(\text{MHz}) = \frac{\text{specified normal stored writing speed (cm/µs)}}{10}$$

The vertical deflection coefficient is set to give a signal display having a peak-to-peak amplitude of 3.18 cm ($10/\pi$ cm).
The horizontal deflection coefficient is set to give two-signal periods in 1 cm (20 periods on a 10 cm screen).
A display is then stored by triggering the horizontal deflection circuit to make one single scan across the screen (single sweep).
Compliance is met if the stored display is clearly visible without breaks over the area specified by the manufacturer and if there are no unwanted bright areas on the screen, both checked after the time interval specified by the manufacturer.

3.2 *Checking of the enhanced (fast) stored writing speed*

The test procedure to check the enhanced (fast) stored writing speed is the same as that given in Sub-clause 3.1.

Note. — It should be noted that the enhanced (fast) stored writing operation is only obtained to the detriment of other characteristics (e.g. storage time, contrast, etc.).

3.3 *Checking of the horizontal resolution*

A sinusoidal signal of 100 Hz is applied to the vertical deflection input terminals.
The vertical deflection coefficient is set to give a signal display having a peak-to-peak amplitude approximately twice the height of the vertical graticule dimension.

The horizontal deflection coefficient is set to give the specified number of lines falling on a 1 cm horizontal section of the screen*.

A display is then stored by triggering the horizontal deflection circuit to make one single scan across the screen (single sweep).

Compliance is met if the stored display resolves the specified number of discrete lines on a 1 cm section in the middle of the screen.

Notes 1. — Since the horizontal and vertical resolutions are not necessarily the same, it may be necessary to check the vertical resolution using the same procedure but interchanging the horizontal and vertical input signals

2. — This measurement is dependent upon the control settings and this test is usually performed under the conditions given in Clause 3, Item 2).

3. — Due to the widely varying results obtained by this test procedure, the manufacturer will not usually specify this performance characteristic.

3.4 *Checking of the display time*

The same test procedure is to be followed as described in Sub-clause 3.1, but additionally a clock is started at the moment of triggering the single sweep. After the time specified by the manufacturer, none of the following defects shall be noticeable:

— brightening of the background to 30% of the maximum trace luminance level (see Sub-clause 3.6);

— thickening of the trace width to twice its initial value;
— breaks that are longer than the trace width.

Note. — To facilitate the measurement, the displayed signal should be positioned away from the bright areas of the screen.

3.5 *Checking of the retention time*

The same test procedure is to be followed as described in Sub-clause 3.1. Immediately after the single sweep ends, the oscilloscope is switched to "stored" mode of operation and a clock is started. After the time specified by the manufacturer, the oscilloscope is switched to "display" mode of operation.

Compliance is met if the display shows none of the defects described in Sub-clause 3.4.

Note. — The display time of a bistable cathode-ray tube is usually equal to the retention time, whereas the display time of a half-tone cathode-ray tube is usually shorter than the retention time.

3.6 *Checking of the stored luminance*

The horizontal deflection coefficient is set to approximately 1 ms/cm and the sweep is set to the free running mode.

The horizontal trace is now moved by means of the vertical positioning control from the top to the bottom of the graticule in such a way that the stored traces lie sufficiently close to each other to create a continuous bright display area.

The average luminance of the stored display is measured with a photometer (see Sub-clauses 2.6.1.1 and 2.6.1.2).

Compliance is met if the measured stored luminance is equal to or greater than the specified value.

Note. — The stored luminance for only a few stored line traces may be greater than the stored luminance when the full screen is stored. In such a case, the manufacturer may specify a smaller stored area for the measurement of this characteristic.

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* The centre portions of a sine-wave can be regarded as being parallel when a two-fold magnification is in operation.

3.7 *Checking of the stored contrast ratio*

The horizontal deflection coefficient is set to approximately 1 ms cm and the sweep is set to the free running mode.

The horizontal trace is now moved by means of the vertical positioning control from the top to the middle of the graticule in such a way that the stored traces in the upper half of the screen lie sufficiently close to each other to create a continuous bright display area.

The average luminances of the swept and unswept areas are measured with a photometer immediately after the upper screen area has been swept.

Compliance is met if the ratio of the measured luminances is equal to or greater than the specified value.

3.8 *Checking of the stored luminance uniformity ratio*

The test procedure described in Sub-clause 3.6, with the exception of the measurement, is repeated.

The highest and lowest luminances of the stored display are measured with a photometer responding to an area of 20 mm^2.

Compliance is met if the ratio of the highest and lowest luminances does not exceed the specified value.

3.9 *Checking of the erase time*

The test procedure described in Sub-clause 3.6, including the measurement, is repeated.

The erase control is operated and the output of the photometer is recorded. The erase time is equal to the time interval necessary for the luminance to fall to 10% of its initial value.

Compliance is met if the erase time is equal to or less than that specified by the manufacturer.

Note. — If there is a remote erase facility, this may be used to initiate the erasing operation by applying an erasing pulse as specified by the manufacturer.

3.10 *General remark*

The stored luminance, the stored writing speed, the retention time and the storage contrast ratio may vary with time. The statements made about them shall be given as a function of operating time of the cathode-ray tube.

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